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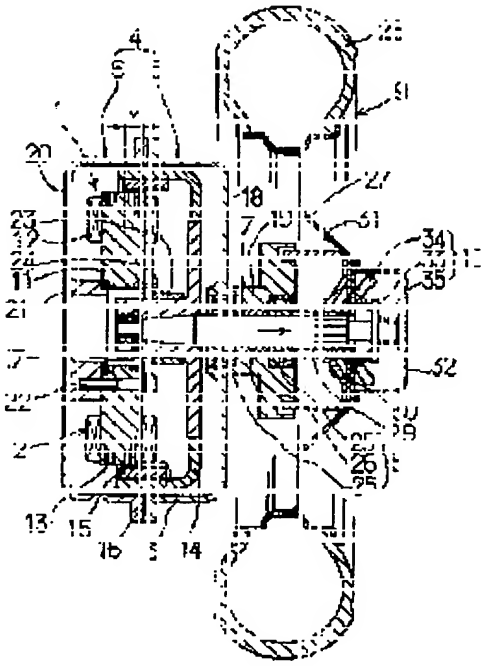
(54) DRIVER FOR MOTOR OPERATED VEHICLE

(57)Abstract:
PURPOSE: To provide a driver for a motor operated vehicle in which a large torque is generated in a low speed range and a high speed rotation is performed.
CONSTITUTION: A rotary shaft 7 is so thrustfully supported as to generate an axial relative displacement between a rotor 3 and a stator 2 of a DC motor. A centrifugal governor mechanism 10 for so driving the shaft 7 as to reduce an opposed area between a rotor pole 16 and a stator pole 13 upon rising of a rotating speed of a wheel 9 is provided. Generated torque is increased at the time of a low speed to increase a maximum rotating speed at the time of a high speed by regulating an effective magnetic flux amount crossing an armature winding 12 in response to a vehicle speed by the mechanism.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The driving gear both for a motor car characterized by providing a magnetic-flux accommodation means to adjust the amount of effective magnetic flux which interlinks the wheel of a car to the armature winding of said motor in the driving gear both for a motor car which carries out a rotation drive by making a direct current motor into a driving source.
[Claim 2] It is the driving gear both for a motor car according to claim 1 which said direct current motor has the structure where a rotator magnetic pole and a stator magnetic pole counter in the direction of a path, and consists of a thrust device in which the relative variation rate of the direction of an axis is produced between the rotator of this motor, and a stator so that said magnetic-flux accommodation means may change the opposed face product of the rotator magnetic pole of said motor, and a stator magnetic pole.
[Claim 3] It is the driving gear both for a motor car according to claim 2 which the revolving shaft of said rotator is combined with this wheel in the condition that only the variation rate to the direction of an axis is permitted between said wheels, and consists of a centrifugal centrifugal-spark-advancer style which drives said revolving shaft so that said thrust device may decrease the opposed face product of said rotator magnetic pole and stator magnetic pole with the rise of the rotational speed of said wheel.
[Claim 4] Said thrust device is a driving gear both for a motor car according to claim 2 which consists of an actuator to which the variation rate of said stator is made to carry out in the direction of an axis so that the output signal of a speed detection means to detect the rotational speed of a motor may be followed and the opposed face product of the rotator magnetic pole of said motor and a stator magnetic pole may be decreased with the rise of rotational speed.
[Claim 5] Said thrust device is a driving gear both for a motor car according to claim 2 which consists of a manual operation member connected with the stator of said motor, and a manual operation device to which the variation rate of said stator is made to carry out in the direction of an axis so that the opposed face product of the rotator magnetic pole of said motor and a stator magnetic pole may be changed by actuation of this manual operation member.
[Claim 6] It is the driving gear both for a motor car according to claim 1 which said direct current motor has the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of an axis, and consists of a thrust device in which a relative change of the direction of an axis is produced between said rotators and stators of this motor so that said magnetic-flux accommodation means may change the gap between the rotator magnetic pole of said motor, and a stator magnetic pole.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the driving gear both for a motor car which carries out the rotation drive of the wheel of the car which makes a direct current motor a driving source.
[0002]
[Description of the Prior Art] The driving gear both for a motor car which was made to carry out the rotation drive of the wheel of this car by making into a driving source the direct current motor which operates by DC power supplies, such as a dc-battery carried in the car, is known.
[0003] There are some which are used for the electromotive car indicated by JP,3-128789,A as this conventional kind of a driving gear. The effectiveness of a motor makes the rotational speed of a wheel change gears automatically, where the rotational frequency of the predetermined range near the rotational frequency which becomes max is maintained, and enables it to mitigate the motor load at the time of low-speed rotation of a wheel in this driving gear by transmitting rotation of a motor to a wheel through the driving mechanism which has an automatic centrifugal clutch and a belt type automatic transmission.
[0004] Moreover, the wheel in motor which was developed as an object for electric vehicles and which made the motor for a drive build in a wheel as a thing is reported (the 1992 motor technical symposium "the wheel in motor for electric automatic persons"). This motor is the brush loess direct current motor of the outer rotor structure where the rotator which constitutes a permanent magnet field rotates the outside of the stator which has an armature winding, it is incorporated into a wheel, a direct tire is attached in that rotator, and that drive current is controlled by the motor controller and the inverter.
[0005]
[Problem(s) to be Solved by the Invention] In the driving gear both for a motor car, big generating torque is needed at the time of the low-speed transit at the time of start of a car and a climb etc. Moreover, at the time of flat-ground stationary transit, although generating torque may be comparatively small, it is required that high-speed operation should be possible.
[0006] They are [magnetic flux / which interlinks the applied voltage of an armature winding to V, and generally interlinks the number of turns of N and an armature winding for rotational speed to n and an armature winding in a direct current motor / armature current / phi and] T and a comparison constant about R and generating torque in resistance of i and a coil K1, K2, and K3 When it carries out V=K1 Nn phi+Ri It reaches. T=K2 iphi -- (1),
******(ing), an output P and effectiveness eta serve as P=K3 NT and eta=P/Vi, respectively. The property of an output P and the generating torque tau over the rotational speed N of a motor changes with flux linkages phi of an armature winding.
[0007] For drawing 8 , the magnitude of the flux linkage phi of an armature winding is phi 1, respectively. And it is the mimetic diagram (in the case of phi 2, effectiveness eta is shown) having shown the rotational sp ed N of a motor, and an output P and relation with the generating torque T about the case wher it is phi 2 (phi1 > phi 2). As shown in this drawing, it is the large value phi 1 about the flux linkage of an armature winding. If it selects It is the small value phi 2 about a flux linkage so that high-speed rotation may no longer be obtained and necessary generating torque may be acquired conversely also in a high-speed region, although generating torque in a low-speed area can be enlarged. When it selects, it

becomes impossible to acquire big generating torque in a low-speed area.
[0008] Since the conventional driving gear used for the electromotive car indicated by JP,3-128789,A operated where the rotational frequency of the predetermined range near [where the effectiveness of a motor becomes max] the rotational frequency is maintained, its effectiveness of a motor is good, and although a wheel could make generate big torque at the time of the low speed of a car since the wheel was driven through the belt type automatic transmission, it had the problem that where of decline in the effectiveness by the driving mechanism arises. Moreover, in this driving gear, since an automatic transmission was needed, it was unavoidable that cost becomes high.
[0009] Next, in the conventional driving gear which made the motor for a drive build in a wheel, although the efficiency of transmission was good since the direct drive of the wheel was carried out with the motor, when generating torque required to a low-speed area was acquired, the motor of a big output was needed, and there was a problem that a motor became large-sized. Moreover, although control was made possible in this conventional driving gear to the rotational-speed field which exceeded the rated speed by performing field-weaking control using a control circuit, there was a problem that effectiveness got remarkably bad and the drive current of a motor became larger than the time of a stationary, in the rotational-speed field beyond a rated speed.
[0010] The purpose of this invention is to offer the driving gear both for a motor car which also enabled high-speed operation while enabling it to acquire big generating torque by the low-speed area, without using an automatic gear change device or large-sized-izing a motor.
[0011]
[Means for Solving the Problem] This invention is a driving gear both for a motor car which carries out the rotation drive of the wheel of a car by making a direct current motor into a driving source, and in this invention, it establishes a magnetic-flux accommodation means to adjust the amount of effective magnetic flux interlinked to the armature winding of a motor in order to attain the above-mentioned purpose.
[0012] When using the thing of the structure where a rotator magnetic pole and a stator magnetic pole counter in the direction of a path, as a direct current motor, the thrust device in which the relative variation rate of the direction of an axis is produced between the rotator of a motor and a stator so that the opposed face product of the rotator magnetic pole of a motor and a stator magnetic pole may be changed can constitute the above-mentioned magnetic-flux accommodation means.
[0013] The centrifugal centrifugal-spark-advancer style which drives a revolving shaft so that the opposed face product of a rotator magnetic pole and a stator magnetic pole may be decreased with the rise of the rotational speed of a wheel can constitute the above-mentioned thrust device. In this case, this revolving shaft is combined with a wheel in the condition that the variation rate to the direction of an axis is permitted between the revolving shaft of the rotator of a direct current motor, and a wheel.
[0014] The above-mentioned thrust device is controlled by the output signal of a speed detection means to detect the rotational speed of a motor again, and the actuator to which the variation rate of the stator is made to carry out in the direction of an axis so that the opposed face product of a rotator magnetic pole and a stator magnetic pole may be decreased with the rise of rotational speed can also constitute it.
[0015] The manual operation device to which the variation rate of the stator of a motor is made to carry out in the direction of an axis so that the opposed face product of the rotator magnetic pole of a motor and a stator magnetic pole may be changed again by actuation of the manual operation member connected with the stator of a motor and this manual operation member can also constitute the above-mentioned thrust device.
[0016] When the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of an axis uses as a motor, the thrust device in which the relative variation rate of the direction of an axis is produced between the rotator of this motor and a stator so that the gap between a rotator magnetic pole and a stator magnetic pole may be changed can constitute the above-mentioned magnetic-flux accommodation means.
[0017]
[Function] If the amount of effective magnetic flux which interlinks the wheel of a car to the armature winding of the direct current motor which carries out a rotation drive is adjusted with a magnetic-flux accommodation means, it becomes possible to adjust the rotational frequency output characteristics of

this motor according to the size of the amount of effective magnetic flux, it can enlarge generating torque at the time of a low speed, and can make high the maximum ngine speed which can reach at the time of a high speed.

[0018] If the thrust device in which the relative variation rate of the direction of an axis is produced is established between the rotator of this motor, and a stator and it changes the opposed face product of a rotator magnetic pole and a stator magnetic pol according to this thrust device in using the direct current motor which has the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of a path, the amount of effective magnetic flux interlinked to an armature winding according to the magnitude of the opposed face product can be adjusted.

[0019] If the centrifugal centrifugal-spark-advancer style which drives a revolving shaft constitutes a thrust device so that the opposed face product of a rotator magnetic pole and a stator magnetic pole may be decreased with the rise of the rotational speed of a wheel, this amount of effective magnetic flux can be adjusted so that the amount of effective magnetic flux interlinked to an armature winding with the rise of rotational speed may decrease. Therefore, at the time of a low speed, the amount of effective magnetic flux can be made [many], generating torque of a motor can be enlarged, the amount of effective magnetic flux can be made small with the rise of rotational speed, the maximum shaft speed which can reach can be made high, and it becomes possible to operate a motor near the horsepower output in each rotational speed.

[0020] Also when the actuator to which the variation rate of the stator is made to carry out in the direction of an axis constitutes the above-mentioned thrust device so that the opposed face product of a rotator magnetic pole and a stator magnetic pole may be decreased with the rise of the rotational speed of a motor, generating torque can be enlarged in a low-speed field, and the maximum shaft speed which can reach can make high in a high-speed field by adjusting this amount of effective magnetic flux so that the rise of rotational speed may be decreased with the amount of effective magnetic flux interlinked to an armature winding.

[0021] If the manual operation device to which the variation rate of the stator of a motor is made to carry out in the direction of an axis is used as the above-mentioned thrust device so that the opposed face product of the rotator magnetic pole of a motor and a stator magnetic pole may be changed, according to the vehicle speed corresponding to the rotational speed or this rotational speed of a motor, the amount of flux linkages of an armature winding can be adjusted by manual operation.

[0022] In using the direct current motor of the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of an axis According to the thrust device in which the relative variation rate of the direction of an axis is produced between the rotator of this motor, and a stator so that the gap between a rotator magnetic pole and a stator magnetic pole may be changed When the above-mentioned magnetic-flux accommodation means is constituted, the amount of effective magnetic flux which the magnetic reluctance of this gap is changed and is interlinked to an armature winding can be changed by changing the gap between a rotator magnetic pole and a stator magnetic pole according to this thrust device.

[0023]

[Example] Drawing 1 is what showed the structure of the 1st example of this invention, and it makes the variation rate of the revolving shaft of the rotator of a motor carry out in the direction of an axis according to the thrust device which consists of a centrifugal centrifugal-spark-advancer style, and he is trying to adjust the amount of effective magnetic flux interlinked to an armature winding in this example by decreasing the rise of the rotational speed of a wheel with the opposed face product of the stator magnetic pole and rotator magnetic pole which counter in the direction of a path.

[0024] As for the bearing to which the direct current motor with which 1 consists of a stator 2 and a rotator 3, motor housing which 4 consists of casing 5 and covering 6, and holds a motor 1, and 7 support a revolving shaft 7 to the revolving shaft of a rotator 3, and 8 supports it to casing 5, and 9, in this drawing, a wheel and 10 are centrifugal centrifugal-spark-advancer styles.

[0025] The direct current motor 1 of this xample is the brushless motor of outer rotor structure, a stator 2 consists of a stator core 11 which mad th 3n piece (n is 4 at an integ r) salient pole section project from the annular yoke section to a radial, and an armatur winding 12 constituted by carrying out three-phase-circuit connection of the coil wound around each salient pole section of this stator core, and the periphery side edge section of each salient pole section serves as the stator magnetic

pole 13. The three-phase-circuit output terminal of an armature winding 12 is connected to the output terminal of the below-mentioned inverter circuit. The rotator 3 consists of what attached the permanent magnet 15 in the peripheral wall section inner circumference of the cup-like flywheel 14 mostly. A permanent magnet 15 is magnetized in the direction of a path, and forms the rotator magnetic pole 16 of the stator magnetic pole 13 and 2n pole which counters in the direction of a path. A boss 17 is formed in the center of the bottom wall section of a flywheel 14, this boss 17 is attached in the end of a revolving shaft 7, and the rotator 3 is attached in the revolving shaft 7.

[0026] Casing 5 consists of a light alloy etc., has the cup-like section 18 and a bearing support 19, and is supporting the revolving shaft 7 by the bearing 8 fitted in the bearing support 19. This casing 5 is being fixed to the car body of the car which is not illustrated.

[0027] Covering 6 consists of a light alloy etc., it has the cup-like section 20 and the stator attachment section 21 prepared in the bottom wall center section of this cup-like section, and the stator core 11 is attached in the stator attachment section 21 according to **** 22. Where the opening side of each cup-like section 18 and 20 is compared, it is mutually combined by **** (not shown), and the direct current motor 1 will be covered with both the cup sections 18 and 20 by casing 5 and covering 6.

[0028] In order to detect the angle-of-rotation location of the magnetic pole of a rotator 3, the magnet 23 for rotator location detection which fixed on the periphery of the boss 17 of a rotator 3, and three rotator location sensors 24 which consist of hall devices attached in the annular section of a stator core 11 at intervals of 120 degrees so that this may be surrounded are formed.

[0029] Bearing 8 is constituted by two ball bearings 25 and the sleeve 26 arranged in the meantime, and is supporting the revolving shaft 7 possible [sliding of the direction of an axis] free [rotation].

[0030] The wheel 9 consists of a tire 28 with which the periphery of a rim 27 and this rim was equipped. A body 29 is fixed to the center section of the rim 27, and fitting of this body 29 is carried out to the revolving shaft 7 through the spline 30. Thereby, the revolving shaft 7 and the wheel 9 of each other are combined in the condition that only the variation rate of the direction of an axis is permitted, between the revolving shaft 7 and the wheel 9. The fender 31 mostly formed in the shape of a cup in the condition of surrounding a body 29 is fixed to the field by the side of the bearing 8 of a rim 27, and the centrifugal-spark-advancer covering 32 is attached in the fender 31 of a rim 27, and the field of the opposite side in the condition of surrounding the centrifugal centrifugal-spark-advancer style 10.

[0031] The flange section 33 which the centrifugal centrifugal spark advancer device 10 fixed in the location of the other end approach of a revolving shaft 7, The centrifugal weight 34 of the pair to which press one field of the flange section 33 and the variation rate of the revolving shaft 7 is made to carry out in the direction of an arrow head of illustration when this flange section 33 is approached, it is supported free [rotation] near the center section of the rim 27 of a wheel and a centrifugal force acts, It is constituted by the spring 35 which oppresses the field of another side of the flange section 29, and energizes a revolving shaft 7 in the direction opposite to the direction of an arrow head of illustration.

[0032] If the variation rate of the direction of an axis is produced by the centrifugal centrifugal-spark-advancer style 10 between a revolving shaft 7 and a wheel 9, the opposed face product of the stator magnetic pole 13 and the rotator magnetic pole 16 will change, and the amount phi of effective magnetic flux interlinked to an armature winding 12 will change. Rotational speed NL predetermined in the rotational speed N of a wheel 9 The variation rate of the direction of an axis of a revolving shaft 7 is regulated so that the center position of the direction of an axis of the rotator magnetic pole 16 may be maintained in the following within the limits by the condition (it sets to drawing 1 and is the condition of x= 0) of being mostly in agreement with the direction center position of an axis of the stator magnetic pole 13, and in this condition, the amount phi of flux linkages of an armature winding is maximum phiL mostly. It has become. Rotational speed NL predetermined in the rotational speed N of a wheel 9 It exceeds, and when it goes up, a revolving shaft 7 is made to carry out a variation rate in the direction of an arrow head of illustration with the rise of rotational speed by the centrifugal-spark-advancer style 10. In connection with this, the opposed face product of the stator magnetic pole 13 and the rotator magnetic pole 16 decreases, and the amount phi of flux linkages of an armature winding 12 decreases. rotational speed -- further -- going up -- predetermined rotational speed NH reaching -- the amount phi of flux linkages of an armature winding -- phiH up to -- if it falls, even if rotational speed N rises further, the variation rate to the direction of an arrow head of illustration of a revolving shaft 7 will not arise -- as -- the variation rate of a revolving shaft 7 -- the amount is regulated.

[0033] the thing illustrating the relation of the above [drawing 2] — it is — the right half part of this drawing (A) — the rotational speed N of a wheel 9, and the variation rate of the direction of an axis of a revolving shaft 7 — relation with an amount x — moreover, the left half part of this drawing (A) — the variation rat of the direction of an axis of a revolving shaft 7 — the relation between an amount x and th amount phi of flux linkages of an armature winding 12 is shown. From these relation, when it asks for the rotational speed (therefore, rotational speed of a motor 1) N of a wheel 9, and relation with the amount phi of flux linkages of an armature winding, it comes to be shown in drawing 2 (B). The relation betw en this rotational speed N and the amount phi of flux linkages of an armature winding is the predetermined rotational speed NL and NH. Within the section of a between, the property of a motor 1 and the centrifugal centrifugal-spark-advancer style 10 is selected so that the output P of a motor 1 may serve as a peak price mostly.

[0034] Drawing 3 is what showed the control system for controlling the rotational speed of a direct curr nt motor 1, and can use a thing well-known as this control system. In this drawing, it is the pot ntiometer by which, as for 36, the accelerator grip of the handle of a car was connected with the acc lerator grip 36, as for 37, the moving contact was connected, and direct current voltage was impressed to both ends, and the moving contact of a potentiometer 37, the signal (location detecting signal of an accelerator grip) acquired between installation, and the phasing signal of the rotator 3 det cted by the rotator location sensor 24 are inputted into the controller 38. The controller 38 has the microcomputer, and determines the duty factor of the current energized to a motor 1 based on the output signal of the location detecting signal obtained from a potentiometer 37, and the speed sensor which is not illustrated, and determines the phase of the alternating field in an armature winding 12 based on the output signal of the rotator location sensor 24, and gives the switching signal showing the duty factor about each armature winding 12, and a phase to the drive circuit 39.

[0035] In addition, in order to prevent that a high current flows to a motor 1 at the time of start of a car, the output signal of the motor current detecting circuit which is not illustrated is inputted into a controller 38, and a duty factor is controlled so that the drive current of the motor at the time of start does not become excessive by this controller.

[0036] The drive circuit 39 has the gate drive circuit 40 and the switching circuit 41. A gate drive circuit 40 is used as a controller 38, and connection of the switching circuit 41 is carried out to the armature winding 12 of each phase of a motor 1, respectively. A switching circuit 41 is what carried out parallel connection of three pairs of FET (field-effect transistor)42 by which connection was carried out to the serial between a dc-battery 43 and touch-down, and diode 44 is formed between the source drains of ach FET42, respectively. The gate of each FET42 is connected to a gate drive circuit 40, and the source drain connection of FET of each set is connected to the input terminal of the armature winding 12 of each phase.

[0037] The drive circuit 39 changes the magnitude of this drive current according to the rotation location of the accelerator grip 36 while passing the drive current which makes the armature winding 12 of a motor 1 produce alternating field by carrying out on-off control of each FET42 based on the SUITCHINKU signal which a controller 38 outputs.

[0038] Drawing 4 is a mimetic diagram for explaining output characteristics in case the duty factor of the direct current motor 1 obtained in this example is 100%. The left half part of this drawing shows the relation (refer to drawing 2 (B)) between the amounts phi of flux linkages of the armature winding 12 adjusted by the rotational speed N and the magnetic-flux accommodation means (thrust device which consists of a centrifugal centrifugal-spark-advancer style 10) of a motor 1. The right half part of this drawing showed the rotational speed N of a motor 1, the output P of this motor, and the relation betw en the generating torque T.

[0039] For the curves P (phiL), P (phi 1), and (phi 2) P (phiH) shown with the broken line in drawing 4 , the amount phi of flux linkages of an armature winding 12 is phiL, phi 1, and phi 2, respectively. And the output P of the motor 1 at the time of being maintained at one constant value each of phiH (phiL >phi1 >phi2 >phiH) is shown. For th se output performance diagrams, rotational speed N is NL, N1, and N2, respectively. When it reaches and is NH (NL <N1 <N2 <NH), it is a horsepower output Pm mostly. It is th becoming property.

[0040] Moreov r, for the straight lines T (phiL), T (phi 1), T (phi 2), and T (phiH) shown with the chain line in drawing 4 , similarly, the amount phi of flux linkages of an armature winding 12 is phiL, phi 1, and

phi 2. And the generating torque T of the motor 1 in the case of being one constant value each of phiH is shown. As this example showed to the left half part of drawing 4 , for the amount phi of flux linkages of an armature winding 12, rotational speed N is NL. In the following fields, it is constant value phiL. It is held and rotational speed N is NH. In the above field, it is constant value phiH. It is held. rotational speed -- NL from -- NH up to -- the field of a between -- rotational speed N -- NL ->N1 ->N2 ->NH it goes up -- alike -- taking -- the amount phi of flux linkages -- phiL ->phi1 phi2 ->phiH It is adjusted so that it may decrease. therefore, the continuous line showed the output P of a motor 1 to the right half part of this drawing -- as -- rotational speed -- NL the following fields -- Curve P (phiL) -- meeting -- changing -- rotational speed -- NL from -- NH up to -- it is maintained in the field of a between by the value near the horsepower output Pm of about 1 law. Moreover, rotational speed is NH. In the above field, it becomes the property of changing along with Curve P (phiH). Similarly the generating torque T of a generator 1 will change in accordance with the characteristic curve shown as the continuous line as an envelope of straight lines T (phiL), T (phi 1), T (phi 2), and T (phiH) by the right half part of drawing 4 . Therefore, as shown in this drawing, while big generating torque is acquired by the low-speed area, the property in which high-speed rotation is also possible can be acquired.

[0041] Drawing 5 is a mimetic diagram for explaining the vehicle speed obtained by the driving gear of this example, respectively at the time of the flat-ground transit with the comparatively light transit load of a car, and a climb with a large transit load, when operating a motor 1 at duty factor 100%.

[0042] the output characteristics of the motor which showed the curves P (phiL) and P (phiH) shown with the broken line to drawing 4 with this notation in this drawing -- corresponding -- the amount phi of flux linkages of an armature winding -- respectively -- constant value phiL And phiH it is -- the relation between the vehicle speed V of a case and the output P of a motor is shown. In drawing 5 , the curves P shown as the continuous line are the output characteristics of the motor 1 acquired by this example. Moreover, curve L1 shown in this drawing with the chain line And L2 The vehicle speed V at the time of flat-ground transit and a climb and relation with the transit load L are shown, respectively.

[0043] In drawing 5 , the vehicle speed obtained by the driving gear is called for as the vehicle speed in the intersection of the output characteristic curve of a motor, and a transit load curve. As shown in this drawing, in the driving gear of this example, the vehicle speed at the time of flat-ground transit is set to V1 (V1H), and the vehicle speed at the time of a climb is set to V2. on the other hand, the amount phi of flux linkages of an armature winding -- respectively -- constant value phiL And phiH it is -- the vehicle speed at the time of flat-ground transit is set to V1L and V1H (V1), respectively, and the vehicle speed at the time of a climb is set to V2L and V2H at a case, respectively. If the amount of flux linkages of an armature winding is selected to large value phiL (fixed), although the transit property at the time of a climb is good, if high-speed transit becomes impossible at the time of flat-ground transit and the amount of flux linkages of an armature winding is conversely selected to small value phiH (fixed), although high-speed transit in the flat ground is possible, the transit property at the time of a climb will worsen.

[0044] On the other hand, a transit property good also at the time of the time of flat-ground transit and a climb will be acquired at the case of the driving gear of this example.

[0045] Drawing 6 is what showed the structure of the 2nd example of this invention, in this example, by a direct current motor's having the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of a path, making the variation rate of the stator carry out in the direction of an axis, and changing the opposed face product of a stator magnetic pole and a rotator magnetic pole according to the rotational speed of a motor, he is trying to adjust the amount of flux linkages of an armature winding, and the same sign as drawing 1 is given to the considerable part equivalent to each part of drawing 1 .

[0046] In drawing 6 , a revolving shaft 7 is supported free [rotation] by two ball bearings 25 fitted in the bearing support 19 of casing 5, and the rotator 3 is attached in the end side of this revolving shaft 7. Fitting of the body 29 prepared in the center section of the rim 27 of a wheel 9 is carried out to the other end side of a revolving shaft 7, and the wheel 9 is fixed to the revolving shaft 7 with the nut 45.

[0047] 46 is a stator attachment member and this stator attachment member has the cylinder section 47 extended in the direction of an axis, and the flange 48 prepared in the end side of this cylinder section 47. The cylinder section 47 is supported by the sliding bearing 49 fitted in bearing prepared in the bottom wall center section of the cup-like section 20 of covering 6, and a stator 2 ****s it to a

flange 48, and it is attached by 22. The stator attachment member 46 is supported by the sliding bearing 49 in the condition that only the variation rate to the direction of an axis is permitted between coverings 6. Between the bottom wall section of the cup-like section 20 of covering 6, and the flange 48 of the stator attachment member 46, the spring 50 which oppresses this flange 48 and energizes the stator attachment member 46 in the direction opposite to th direction of an illustration arrow head is arranged.

[0048] The amount of flux linkages of an armature winding 12 is adjusted by connecting with the other end 51 of the stator attachment member 46 the actuator which is not illustrated, making the variation rate of the stator attachment member 46 carry out in the direction of an arrow head of illustration with a stator 2 with this actuator, and carrying out the variation rate of the opposed face product of the stator magnetic pole 13 and the rotator magnetic pole 16. Driving sources, such as a well-known sol noid or a torque motor, and the drive circuit which drives this driving source can constitute this actuator. This actuator is controlled by the output signal of the rate detector (not shown) which detects the vehicle speed corresponding to the rotational speed or this rotational speed of a motor 1, the attraction of the direction of an arrow head of the illustration which increases with the rise of the rotational speed of a motor 1 is generated, and the variation rate of the direction location of an axis of a stator 2 is carried out to the location where this attraction and the suppression force of a spring 50 balance. When setting up the property of an actuator and a spring 50 so that relation with the amount phi of flux linkages of the armature winding 12 when a stator 2 is made to carry out a variation rate according to the rotational speed N and this rotational speed of a motor 1 might become being the same as that of the relation shown in drawing 2 (B), the output characteristics of a motor 1 were able to be shown in drawing 4 .

[0049] Although the thrust device to which made it make the variation rate of the stator carry out in the direction of an axis with the actuator controlled by the detecting signal of the rotational speed of a motor was used in the above-mentioned example, the thrust device to which the variation rate of the stator 2 is made to carry out in the direction of an axis by manual operation is also employable. In this case, by connecting the stator 2 and manual operation member of a motor 1 with a connection means, and operating this manual operation member with hand control, the variation rate of the stator 2 is made to carry out in the direction of an axis, and the opposed face product of the rotator magnetic pole 16 and the stator magnetic pole 13 is changed. For example, the end of the wire as a connection means is combined with the grip or lever prepared in the handle of a car as a manual operation member, and the other end of this wire is combined with the other end 51 of the stator attachment member 46 (refer to drawing 6). In this case, by operating a grip or a lever with hand control according to the rotational speed of a motor 1, or the vehicle speed of a car, and making the variation rate of the stator 2 carry out in th direction of an axis, the amount of flux linkages of an armature winding 12 can be adjusted, and the output characteristics of a motor 1 can be changed.

[0050] Although the rotator had the outer rotor structure of rotating the outside of a stator, as a direct current motor in each above example, what has inner rotor structure can also be used as this motor. The stator by which the motor in this case comes to wind an armature winding around each salient pole section of the stator core which turned the salient pole section of 3n (n: integer) individual to the direction inside of a path, and was made to project from the annular yoke section, The rotator which has the rotator magnetic pole of 2n pole which is arranged inside this stator and becomes a periphery from a permanent magnet constitutes, and it considers as the structure of making the stator magnetic pole formed of the point of each salient pole section of a stator core, and a rotator magnetic pole countering in the direction of a path. The device in which the relative variation rate of the direction of an axis is produced between a rotator and a stator with the means to which the variation rate of the means to which the variation rate of the revolving shaft with which the stator was attached is made to carry out in the direction of an axis like the case of said 1st example (refer to drawing 1) or the 2nd example (refer to drawing 6), or the stator is made to carry out in th dir ction of an axis can be used for the thrust device as a magnetic-flux accommodation means to adjust th amount of flux linkages of an armatur winding.

[0051] Drawing 7 is what showed th structure of the 3rd example of this invention, and the magnetic-flux accommodation means is constituted from this example by the thrust device in which the relative variation rate of the direction of an axis is produced between the rotator of this motor, and a stator so

that the gap between the rotator magnetic pole of a motor and a stator magnetic pole may be changed, using what has the structure where a stator magnetic pole and a rotator magnetic pole counter in the direction of an axis, as a direct current motor. In drawing 7 , the same sign as the sign in drawing 1 is given to the considerable part equivalent to each part of drawing 1 .

[0052] The stator 2 of a motor 1 consists of a stator core 54 which made the salient pole section 53 of 3n (n: integer) individual project in the direction of an axis from one field of the direction of an axis of the yoke 52 of an annular disk type, and an armature winding 12 wound around this salient pole section 53 in drawing 7 . The 3n piece salient pole section 53 is formed so that it may rank with a hoop direction by the equiangular distance, and the point of each salient pole section 53 serves as the stator magnetic pole 13. This stator 2 is ****ed in the stator attachment section 21 of covering 6, and is attached by 22.

[0053] The rotator 3 of a motor 1 consists of a permanent magnet 56 fixed to the field of the side which counters a center section with the salient pole section of the stator core of the disc-like magnetic-path configuration member 55 which has a boss 17, and this magnetic-path configuration member 55, and the permanent magnet 56 constitutes the rotator magnetic pole 16 of 2n pole where it is magnetized in the direction of an axis, and a unlike pole is located in a line with a hoop direction by turns. The rotator magnetic pole 16 is made to counter through a gap (cap length g) by the stator magnetic pole 13 and the direction of an axis.

[0054] The rotator 3 is attached in the end side of the revolving shaft 7 with which bearing of the sliding was carried out in rotation and the direction of an axis by bearing 8 possible, and the other end side of this revolving shaft 7 is combined with the wheel 9 in the condition that only the variation rate to the direction of an axis is permitted between wheels 9. The thrust device for producing the relative variation rate of the direction of an axis between the rotator 3 of a motor 1, and a stator 2 It consists of a centrifugal centrifugal-spark-advancer style 10 driven like the case of the 1st example as stated above so that the variation rate of the revolving shaft 7 may be made to carry out in the direction of an illustration arrow head. Gap length g of the direction of an axis between the stator magnetic pole 13 and the rotator magnetic pole 16 is increased with the rise of the rotational speed of a wheel 9, and it operates so that the amount of flux linkages of an armature winding 12 may be decreased.

[0055] Although a magnetic-flux accommodation means to change the gap between the stator magnetic pole 13 and the rotator magnetic pole 16 by making the variation rate of the revolving shaft 7 carry out in the direction of an axis in the direction of an axis by the centrifugal centrifugal-spark-advancer style 10 in support of the revolving shaft 7 of the rotator 3 of a motor possible [displacement] is used in the above-mentioned example As this magnetic-flux accommodation means, like the 2nd example (drawing 6) as stated above by making the variation rate of the stator 2 carry out in the direction of an axis in support of the stator 2 of a motor according to the rotational speed of a motor in the condition that it can displace in the direction of an axis The thrust device to which it was made to change the gap between a stator magnetic pole and a rotator magnetic pole can also be used.

[0056] Although the other end side of the revolving shaft which attached the rotator of a motor in the end side was combined with the direct wheel in each above example, you may make it combine the other end side of a revolving shaft with a wheel through a reduction gear device if needed.

[0057] In each above example, although the direct current motor was a thing of three-phase-circuit structure which has the rotator magnetic pole of 2n (n: integer) pole, and the stator magnetic pole of 3n pole, also when both a rotator magnetic pole and a stator magnetic pole are the single phase structures of 2n pole, this invention can be applied. In this case, also let the control system for controlling the rotational speed of a motor be a single phase control system.

[0058]

[Effect of the Invention] As mentioned above, since it enabled it to adjust the amount of effective magnetic flux interlinked to the armature winding of a motor with a magnetic-flux accommodation means according to this invention, the output of a motor is maintainable in the big condition over the range where rotational speed is large by adjusting the amount of flux linkages of an armature winding according to the rotational speed of a motor. Therefore, there is an advantage which big generating torque is acquired by the low-speed area, and can moreover obtain the driving gear both for a motor car in which high-speed rotation is possible, without using an automatic gear change device or large-sized-izing a motor.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing of longitudinal section showing the structure of the 1st example of this invention.
[Drawing 2] It is a diagram for explaining the relation of the rotational speed and the amount of armature flux linkages in the example of drawing 1 .
[Drawing 3] It is the circuit diagram having shown the example of a configuration of the control system of the motor in the example of drawing 1 .
[Drawing 4] It is a diagram for explaining the output characteristics obtained with the motor in the example of drawing 1 .
[Drawing 5] It is a diagram for explaining the transit property of the car obtained using the example of drawing 1 .
[Drawing 6] It is drawing of longitudinal section showing the structure of the 2nd example of this invention.
[Drawing 7] It is drawing of longitudinal section showing the structure of the 3rd example of this invention.
[Drawing 8] It is the diagram having compared and shown the difference in a motor output in case the amounts of armature flux linkages of a motor differ.
[Description of Notations]
1 Direct Current Motor
2 Stator
3 Rotator
7 Revolving Shaft
9 Wheel
10 Centrifugal Centrifugal-Spark-Advancer Style
11 Stator Core
12 Armature Winding
13 Stator Magnetic Pole
16 Rotator Magnetic Pole

[Translation done.]

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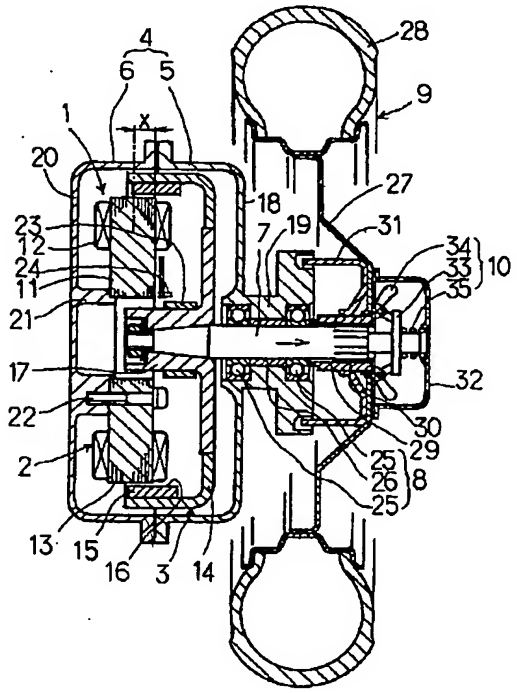
(54)【発明の名称】　電動車両用駆動装置

(57)【要約】

【目的】低速領域で大きなトルクを発生し、しかも高速回転が可能な電動車両用駆動装置を提供する。

【構成】直流電動機の回転子３と固定子２との間に軸線方向の相対変位を生じさせるように、回転軸７をスラスト可能に支持しておく。車輪９の回転速度の上昇に伴って回転子磁極１６と固定子磁極１３との対向面積を減少させるように回転軸７を駆動する遠心ガバナ機構１０を設ける。この遠心ガバナ機構により、車速に応じて電機子巻線１２に鎖交する有効磁束量を調節して、低速時には発生トルクを大きくし、高速時の最高回転数を高くする。



【特許請求の範囲】

【請求項１】　直流電動機を駆動源として車両の車輪を回転駆動する電動車両用駆動装置において、
前記電動機の電機子巻線に鎖交する有効磁束量を調節する磁束調節手段を具備したことを特徴とする電動車両用駆動装置。

【請求項２】　前記直流電動機は、回転子磁極と固定子磁極とが径方向に対向する構造を有し、
前記磁束調節手段は、前記電動機の回転子磁極と固定子磁極との対向面積を変化させるように、該電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構からなっている請求項１に記載の電動車両用駆動装置。

【請求項３】　前記回転子の回転軸は前記車輪との間に軸線方向への変位のみが許容される状態で該車輪に結合され、
前記スラスト機構は、前記車輪の回転速度の上昇に伴って前記回転子磁極と固定子磁極との対向面積を減少させるように前記回転軸を駆動する遠心ガバナ機構からなっている請求項２に記載の電動車両用駆動装置。

【請求項４】　前記スラスト機構は、電動機の回転速度を検出する速度検出手段の出力信号に応動し回転速度の上昇に伴って前記電動機の回転子磁極と固定子磁極との対向面積を減少させるように前記固定子を軸線方向に変位させるアクチュエータからなっている請求項２に記載の電動車両用駆動装置。

【請求項５】　前記スラスト機構は、前記電動機の固定子に連結された手動操作部材と、該手動操作部材の操作により前記電動機の回転子磁極と固定子磁極との対向面積を変化させるように前記固定子を軸線方向に変位させる手動操作機構とからなっている請求項２に記載の電動車両用駆動装置。

【請求項６】　前記直流電動機は、固定子磁極と回転子磁極とが軸線方向に対向する構造を有し、
前記磁束調節手段は、前記電動機の回転子磁極と固定子磁極との間のギャップを変化させるように該電動機の前記回転子と固定子との間に軸線方向の相対的な変化を生じさせるスラスト機構からなっている請求項１に記載の電動車両用駆動装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、直流電動機を駆動源とする車両の車輪を回転駆動する電動車両用駆動装置に関するものである。

【０００２】

【従来の技術】車両に搭載されたバッテリ等の直流電源により作動する直流電動機を駆動源として、該車両の車輪を回転駆動するようにした電動車両用駆動装置が知られている。

【０００３】従来のこの種の駆動装置として、例えば特開平３－１２８７８９号に記載された電動式車両に用いられているものがある。この駆動装置では、電動機の回転を自動遠心クラッチとベルト式自動変速機とを有する伝動機構を介して車輪に伝達することにより、電動機の効率が最大になる回転数の近傍の所定の範囲の回転数を維持した状態で車輪の回転速度を自動的に変速させて、車輪の低速回転時の電動機負荷を軽減できるようにしている。

【０００４】また、電気自動車用として開発されたものとして、駆動用電動機を車輪に内蔵させたホイールインモータが報告されている（１９９２年モータ技術シンポジウム「電気自動者用ホイールインモータ」）。このモータは、電機子巻線を有する固定子の外側を永久磁石界磁を構成する回転子が回転するアウターロータ構造のブラシレス直流電動機で、車輪の中に組み込まれてその回転子に直接タイヤが取り付けられ、モータコントローラ及びインバータによりその駆動電流が制御されるようになっている。

【０００５】

【発明が解決しようとする課題】電動車両用駆動装置では、車両の発進時や登坂時などの低速走行時に大きな発生トルクを必要とする。また平地定常走行時には、発生トルクは比較的小さくてもよいが、高速運転が可能であることが要求される。

【０００６】一般に直流電動機においては、電機子巻線の印加電圧をＶ、回転速度をＮ、電機子巻線の巻数をｎ、電機子巻線に鎖交する磁束をφ、電機子電流をｉ、巻線の抵抗をＲ、発生トルクをＴ、比較定数をＫ１，Ｋ２，Ｋ３ とした場合、

$$V = K1\ N n \phi + R i \quad \text{及び} \quad T = K2\ i \phi \qquad \cdots (1)$$

が成立し、出力Ｐ及び効率ηはそれぞれＰ＝Ｋ３ ＮＴ及びη＝Ｐ／Ｖｉとなる。電動機の回転速度Ｎに対する出力Ｐ及び発生トルクＴの特性は電機子巻線の鎖交磁束φによって異なる。

【０００７】図８は、電機子巻線の鎖交磁束φの大きさがそれぞれφ１ 及びφ２ （φ１ ＞φ２ ）の場合について、電動機の回転速度Ｎと出力Ｐ及び発生トルクＴとの関係を示した（φ２ の場合は効率ηも示す）模式図で、同図からわかるように、電機子巻線の鎖交磁束を大きい値φ１ に選定すると、低速域での発生トルクを大きくすることができるが高速回転が得られなくなり、逆に高速域でも所要の発生トルクが得られるように鎖交磁束を小さい値φ２ に選定すると、低速域において、大きな発生トルクを得ることができなくなる。

【０００８】特開平３－１２８７８９号に記載された電動式車両に用いられていた従来の駆動装置は、電動機の効率が最大になる回転数の近傍の所定範囲の回転数を維持した状態で動作するので、電動機の効率が良好であ

り、またベルト式自動変速機を介して車輪を駆動するので車両の低速時に車輪に大きなトルクを発生させることができるが、伝動機構による効率の低下が生じるという問題があった。またこの駆動装置では、自動変速機を必要とするため、コストが高くなるのを避けられなかった。

【０００９】次に駆動用電動機を車輪に内蔵させた従来の駆動装置では、電動機で車輪を直接駆動するので伝動効率は良いが、低速域まで必要な発生トルクを得るようにすると大きな出力の電動機を必要とし、電動機が大形になるという問題があった。またこの従来の駆動装置では、制御回路を用いて弱め界磁制御を行うことにより定格回転速度を越えた回転速度領域まで制御を可能にしているが、定格回転速度を越えた回転速度領域では、効率が著しく悪くなって電動機の駆動電流が定常時より大きくなるという問題があった。

【００１０】本発明の目的は、自動変速機構を用いたり電動機を大形化したりすることなく、低速域で大きな発生トルクを得ることができるようにするとともに、高速運転をも可能にした電動車両用駆動装置を提供することにある。

【００１１】

【課題を解決するための手段】本発明は、直流電動機を駆動源として車両の車輪を回転駆動する電動車両用駆動装置であって、本発明においては、上記の目的を達成するため、電動機の電機子巻線に鎖交する有効磁束量を調節する磁束調節手段を設ける。

【００１２】直流電動機として、回転子磁極と固定子磁極とが径方向に対向する構造のものを用いる場合には、電動機の回転子磁極と固定子磁極との対向面積を変化させるように電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構により、上記磁束調節手段を構成することができる。

【００１３】上記スラスト機構は、車輪の回転速度の上昇に伴って回転子磁極と固定子磁極との対向面積を減少させるように回転軸を駆動する遠心ガバナ機構により構成することができる。この場合、直流電動機の回転子の回転軸と車輪との間に軸線方向への変位が許容される状態で該回転軸を車輪に結合する。

【００１４】上記スラスト機構はまた、電動機の回転速度を検出する速度検出手段の出力信号により制御されて、回転速度の上昇に伴って回転子磁極と固定子磁極との対向面積を減少させるように固定子を軸線方向に変位させるアクチュエータにより構成することもできる。

【００１５】上記スラスト機構はまた、電動機の固定子に連結された手動操作部材と、該手動操作部材の操作により電動機の回転子磁極と固定子磁極との対向面積を変化させるように電動機の固定子を軸線方向に変位させる手動操作機構とにより構成することもできる。

【００１６】電動機として、固定子磁極と回転子磁極とが軸線方向に対向する構造のもの用いる場合には、回転子磁極と固定子磁極との間のギャップを変化させるように該電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構により上記磁束調節手段を構成することができる。

【００１７】

【作用】車両の車輪を回転駆動する直流電動機の電機子巻線に鎖交する有効磁束量を磁束調節手段により調節するようにすると、有効磁束量の大小に応じて該電動機の回転数出力特性を調節することが可能になり、低速時には発生トルクを大きくし、高速時には到達可能な最高回転数を高くすることができるようになる。

【００１８】固定子磁極と回転子磁極とが径方向に対向する構造を有する直流電動機を用いる場合には、該電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構を設けて、該スラスト機構により回転子磁極と固定子磁極との対向面積を変化させると、その対向面積の大きさに応じて電機子巻線に鎖交する有効磁束量を調節することができる。

【００１９】車輪の回転速度の上昇に伴って回転子磁極と固定子磁極との対向面積を減少させるように回転軸を駆動する遠心ガバナ機構によりスラスト機構を構成すると、回転速度の上昇とともに電機子巻線に鎖交する有効磁束量が減少していくように該有効磁束量を調節することができる。従って、低速時には有効磁束量を多くして電動機の発生トルクを大きくし、回転速度の上昇に伴って有効磁束量を小さくして到達可能な最高回転速度を高くすることができ、各回転速度において電動機を最高出力近傍で動作させることが可能となる。

【００２０】電動機の回転速度の上昇に伴って回転子磁極と固定子磁極との対向面積を減少させるように固定子を軸線方向に変位させるアクチュエータにより上記スラスト機構を構成した場合も、電機子巻線に鎖交する有効磁束量を回転速度の上昇に伴って減少させるように該有効磁束量を調節することにより、低速領域では発生トルクを大きくし、高速領域では到達可能な最高回転速度を高くすることができる。

【００２１】上記スラスト機構として、電動機の回転子磁極と固定子磁極との対向面積を変化させるように電動機の固定子を軸線方向に変位させる手動操作機構を用いると、電動機の回転速度あるいは該回転速度に対応する車速に応じて、手動操作により電機子巻線の鎖交磁束量を調節することができる。

【００２２】固定子磁極と回転子磁極とが軸線方向に対向する構造の直流電動機を用いる場合には、回転子磁極と固定子磁極との間のギャップを変化させるように該電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構により、上記磁束調節手段を構成した場合には、該スラスト機構により回転子磁極と固定子磁極との間のギャップを変化させることにより該

ギャップの磁気抵抗を変化させて電機子巻線に鎖交する有効磁束量を変化させることができる。

【００２３】

【実施例】図１は、本発明の第１実施例の構造を示したもので、この実施例では、遠心ガバナ機構からなるスラスト機構により電動機の回転子の回転軸を軸線方向に変位させて、径方向に対向する固定子磁極と回転子磁極との対向面積を車輪の回転速度の上昇に伴って減少させることにより電機子巻線に鎖交する有効磁束量を調節するようにしている。

【００２４】同図において、１は固定子２と回転子３とからなる直流電動機、４はケーシング５とカバー６とからなっていて電動機１を収容するモータハウジング、７は回転子３の回転軸、８は回転軸７をケーシング５に支持する軸受、９は車輪、１０は遠心ガバナ機構である。

【００２５】この例の直流電動機１はアウタロータ構造のブラシレスモータで、固定子２は環状の継鉄部から３ｎ個（ｎは整数で例えば４）の突極部を放射状に突出させた固定子鉄心１１と、該固定子鉄心の各突極部に巻回されたコイルを３相結線して構成された電機子巻線１２とからなり、各突極部の外周側端部が固定子磁極１３となっている。電機子巻線１２の３相出力端子は後述のインバータ回路の出力端子に接続されている。回転子３は、ほぼカップ状のフライホイール１４の周壁部内周に永久磁石１５を取り付けたものからなっている。永久磁石１５は径方向に着磁されて固定子磁極１３と径方向に対向する２ｎ極の回転子磁極１６を形成している。フライホイール１４の底壁部中央にはボス１７が設けられ、該ボス１７が回転軸７の一端に嵌着されて、回転子３が回転軸７に取り付けられている。

【００２６】ケーシング５は軽合金等からなっていて、カップ状部１８と軸受支持部１９とを有し、軸受支持部１９に嵌装された軸受８により回転軸７を支承している。このケーシング５は図示しない車両の車体に固定されている。

【００２７】カバー６は軽合金等からなっていて、カップ状部２０と該カップ状部の底壁中央部に設けられた固定子取付部２１とを有し、固定子取付部２１には、ねじ２２により固定子鉄心１１が取り付けられている。ケーシング５とカバー６とは、それぞれのカップ状部１８及び２０の開口側を突き合せた状態でねじ（図示せず）により互いに結合され、両カップ部１８及び２０により直流電動機１が覆われた状態になっている。

【００２８】回転子３の磁極の回転角度位置を検出するため、回転子３のボス１７の外周に固着された回転子位置検出用磁石２３と、これを取り囲むように、固定子鉄心１１の環状部に１２０度間隔で取り付けられたホール素子からなる３個の回転子位置センサ２４とが設けられている。

【００２９】軸受８は、２個のボールベアリング２５とその間に配置されたスリーブ２６とにより構成されていて、回転軸７を回転自在にかつ軸線方向に滑動可能に支承している。

【００３０】車輪９は、リム２７と該リムの外周に装着されたタイヤ２８とからなっている。リム２７の中央部には円筒部２９が固定され、該円筒部２９がスプライン３０を介して回転軸７に嵌合されている。これにより、回転軸７と車輪９との間に軸線方向の変位のみが許容される状態で回転軸７と車輪９とが互いに結合されている。リム２７の軸受８側の面には、円筒部２９を取り囲む状態でほぼカップ状に形成された泥よけ３１が固定され、リム２７の泥よけ３１と反対側の面には、遠心ガバナ機構１０を取り囲む状態でガバナカバー３２が取り付けられている。

【００３１】遠心カバナ機構１０は、回転軸７の他端寄りの位置に固着されたつば部３３と、該つば部３３に近接して車輪のリム２７の中央部付近に回動自在に支持されて、遠心力が作用したときにつば部３３の一方の面を押圧して回転軸７を図示の矢印方向に変位させる一対の遠心重錘３４と、つば部２９の他方の面を弾圧して回転軸７を図示の矢印方向と反対の方向に付勢するばね３５とにより構成されている。

【００３２】遠心ガバナ機構１０により回転軸７と車輪９との間に軸線方向の変位が生じさせられると、固定子磁極１３と回転子磁極１６との対向面積が変化して、電機子巻線１２に鎖交する有効磁束量φが変化する。車輪９の回転速度Ｎが所定の回転速度ＮＬ 以下の範囲内では、回転子磁極１６の軸線方向の中心位置が固定子磁極１３の軸線方向中心位置とほぼ一致する状態（図１においてｘ＝０の状態）に維持されるように回転軸７の軸線方向の変位が規制されていて、この状態では電機子巻線の鎖交磁束量φがほぼ最大値φＬ となっている。車輪９の回転速度Ｎが所定の回転速度ＮＬ を越えて上昇すると、回転速度の上昇に伴ってガバナ機構１０により回転軸７が図示の矢印方向に変位させられる。これに伴って固定子磁極１３と回転子磁極１６との対向面積が減少していき、電機子巻線１２の鎖交磁束量φが減少していく。回転速度が更に上昇して所定の回転速度ＮＨ に達し、電機子巻線の鎖交磁束量φがφＨ まで低下すると、回転速度Ｎが更に上昇しても回転軸７の図示の矢印方向への変位が生じないように回転軸７の変位量が規制されている。

【００３３】図２は上記の関係を図示したもので、同図（Ａ）の右半部は車輪９の回転速度Ｎと回転軸７の軸線方向の変位量ｘとの関係を、また同図（Ａ）の左半部は回転軸７の軸線方向の変位量ｘと電機子巻線１２の鎖交磁束量φとの関係を示している。これらの関係から、車輪９の回転速度（従って電動機１の回転速度）Ｎと電機子巻線の鎖交磁束量φとの関係を求めると、図２（Ｂ）に示すようになる。この回転速度Ｎと電機子巻線の鎖交

磁束量φとの間の関係は、所定の回転速度NLとNH との間の区間内では電動機１の出力Ｐがほぼ最高値となるように電動機１及び遠心ガバナ機構１０の特性が選定されている。

【００３４】図３は直流電動機１の回転速度を制御するための制御系を示したもので、この制御系としては公知のものを使用できる。同図において、３６は車両のハンドルのアクセルグリップ、３７はアクセルグリップ３６に可動接触子が連結されて両端に直流電圧が印加されたポテンショメータで、ポテンショメータ３７の可動接触子と設置間に得られる信号（アクセルグリップの位置検出信号）と、回転子位置センサ２４により検出された回転子３の位相信号とがコントローラ３８に入力されている。コントローラ３８はマイクロコンピュータを有していて、ポテンショメータ３７から得られる位置検出信号と図示しない車速センサとの出力信号とに基づいて電動機１に通電する電流のデューティファクタを決定し、また回転子位置センサ２４の出力信号に基づいて電機子巻線１２における交番磁界の位相を決定して、各電機子巻線１２についてのデューティファクタと位相とを表わすスイッチング信号を駆動回路３９に与える。

【００３５】尚車両の発進時に電動機１に大電流が流れるのを防止するため、コントローラ３８には図示しない電動機電流検知回路の出力信号が入力され、該コントローラにより、発進時の電動機の駆動電流が過大にならないようにデューティファクタが制御されるようになっている。

【００３６】駆動回路３９はゲートドライブ回路４０及びスイッチング回路４１を有している。ゲートドライブ回路４０はコントローラ３８に、またスイッチング回路４１は電動機１の各相の電機子巻線１２にそれぞれ結線されている。スイッチング回路４１は、直列に結線された３対のＦＥＴ（電界効果トランジスタ）４２をバッテリ４３と接地との間に並列接続したもので、各ＦＥＴ４２のソース・ドレン間にはそれぞれダイオード４４が設けられている。各ＦＥＴ４２のゲートはゲートドライブ回路４０に接続され、また各対のＦＥＴのソース・ドレン接続部が各相の電機子巻線１２の入力端子に接続されている。

【００３７】駆動回路３９は、コントローラ３８が出力するスイッチンク信号に基づいて各ＦＥＴ４２をオン・オフ制御することにより、電動機１の電機子巻線１２に交番磁界を生じさせる駆動電流を流すとともに、該駆動電流の大きさをアクセルグリップ３６の回動位置に応じて変化させる。

【００３８】図４は本実施例において得られる直流電動機１のデューティファクタが１００%の時の出力特性を説明するための模式図で、同図の左半部は電動機１の回転速度Ｎと、磁束調節手段（遠心ガバナ機構１０からなるスラスト機構）により調節された電機子巻線１２の鎖交磁束量φとの間の関係（図２（Ｂ）参照）を示し、同図の右半部は電動機１の回転速度Ｎと該電動機の出力Ｐ及び発生トルクＴとの間の関係を示したのである。

【００３９】図４において、破線で示した曲線Ｐ（φL），Ｐ（φ1），（φ2）及びＰ（φH）はそれぞれ電機子巻線１２の鎖交磁束量φがφL，φ1，φ2 及びφH （φL ＞φ1 ＞φ2 ＞φH ）の各一定値に保たれた場合の電動機１の出力Ｐを示し、これらの出力曲線は回転速度ＮがそれぞれNL，N1，N2 及びNH （NL ＜N1 ＜N2 ＜NH ）のときにほぼ最高出力Ｐm となる特性となっている。

【００４０】また図４において鎖線で示した直線Ｔ（φL），Ｔ（φ1），Ｔ（φ2）及びＴ（φH）は同じく電機子巻線１２の鎖交磁束量φがφL，φ1，φ2 及びφHの各一定値である場合の電動機１の発生トルクＴを示したものである。本実施例では、図４の左半部に示したように、電機子巻線１２の鎖交磁束量φは回転速度ＮがNL 以下の領域では一定値φL に保持され、また回転速度ＮがNH 以上の領域では一定値φH に保持される。回転速度がNL からNH までの間の領域では回転速度ＮがNL →N1 →N2 →NH と上昇するにつれて鎖交磁束量φがφL →φ１　φ2 →φH と減少していくように調節される。そのため、電動機１の出力Ｐは、同図の右半部に実線で示したように、回転速度がNL 以下の領域では曲線Ｐ（φL）に沿って変化し、回転速度がNL からNH までの間の領域ではほぼ一定の最高出力Ｐm近傍の値に維持される。また回転速度がNH 以上の領域では曲線Ｐ（φH）に沿って変化する特性となる。同様に、発電機１の発生トルクＴは同じく図４の右半部で直線Ｔ（φL），Ｔ（φ1），Ｔ（φ2）及びＴ（φH）の包絡線として実線で示されている特性曲線に沿って変化することになる。従って、同図からわかるように、低速域で大きな発生トルクが得られるとともに、高速回転も可能な特性を得ることができる。

【００４１】図５は、電動機１をデューティファクタ１００%で動作させた場合に、車両の走行負荷が比較的軽い平地走行時、及び走行負荷が大きい登坂時にそれぞれ本実施例の駆動装置により得られる車速を説明するための模式図である。

【００４２】同図において、破線で示した曲線Ｐ（φL）及びＰ（φH）は図４に同記号で示した電動機の出力特性に相当し、電機子巻線の鎖交磁束量φがそれぞれ一定値φL 及びφH の場合の車速Ｖと電動機の出力Ｐとの関係を示している。図５において、実線で示した曲線Ｐは本実施例により得られる電動機１の出力特性である。また同図に鎖線で示した曲線L1 及びL2 は、それぞれ平地走行時及び登坂時における車速Ｖと走行負荷Ｌとの関係を示したものである。

【００４３】図５において、駆動装置により得られる車速は電動機の出力特性曲線と走行負荷曲線との交点にお

ける車速として求められる。同図からわかるように、本実施例の駆動装置では平地走行時の車速はV1 （V1H）となり、登坂時の車速はV2となる。これに対して、電機子巻線の鎖交磁束量φがそれぞれ一定値φL 及びφHである場合には、平地走行時の車速はそれぞれV1L及びV1H（V1 ）となり、登坂時の車速はそれぞれV2L及びV2Hとなる。電機子巻線の鎖交磁束量を大きい値φL（一定）に選定すれば、登坂時の走行特性は良いが平地走行時に高速走行ができなくなり、逆に電機子巻線の鎖交磁束量を小さい値φH （一定）に選定すれば、平地での高速走行は可能であるが登坂時の走行特性が悪くなる。

【００４４】これに対し、本実施例の駆動装置の場合には、平地走行時も登坂時も良好な走行特性が得られることになる。

【００４５】図６は本発明の第２実施例の構造を示したもので、この実施例では直流電動機は固定子磁極と回転子磁極とが径方向に対向する構造を有し、固定子を軸線方向に変位させて固定子磁極と回転子磁極との対向面積を電動機の回転速度に応じて変化させることにより電機子巻線の鎖交磁束量を調節するようにしており、図１の各部と同等の相当部分には図１と同じ符号が付してある。

【００４６】図６において、回転軸７はケーシング５の軸受支持部１９に嵌装された２個のボールベアリング２５により回転自在に支持され、該回転軸７の一端側には回転子３が取り付けられている。回転軸７の他端側には車輪９のリム２７の中央部に設けられた円筒部２９を嵌合させてナット４５により車輪９を回転軸７に固定してある。

【００４７】４６は固定子取付部材で、該固定子取付部材は軸線方向に伸びる円柱部４７と該円柱部４７の一端側に設けられたフランジ部４８とを有している。円柱部４７はカバー６のカップ状部２０の底壁中央部に設けられた軸受部に嵌装された摺動軸受４９により支持され、フランジ部４８には固定子２がねじ２２により取り付けられている。固定子取付部材４６はカバー６との間に軸線方向への変位のみが許容される状態で摺動軸受４９により支持されている。カバー６のカップ状部２０の底壁部と固定子取付部材４６のフランジ部４８との間には、該フランジ部４８を弾圧して固定子取付部材４６を図示矢印方向と反対の方向に付勢するばね５０が配置されている。

【００４８】固定子取付部材４６の他端５１には図示しないアクチュエータが連結されていて、該アクチュエータにより固定子取付部材４６を固定子２とともに図示の矢印方向に変位させて、固定子磁極１３と回転子磁極１６との対向面積を変位させることにより、電機子巻線１２の鎖交磁束量を調節する。このアクチュエータは、公知のソレノイドあるいはトルクモータ等の駆動源と、該駆動源を駆動する駆動回路とにより　成することができる。このアクチュエータは、電動機１の回転速度あるいは該回転速度に対応する車速を検出する速度検出器（図示せず）の出力信号により制御されて、電動機１の回転速度の上昇に伴って増大する図示の矢印方向の牽引力を発生し、該牽引力とばね５０の弾圧力とが平衡する位置まで固定子２の軸線方向位置を変位させる。電動機１の回転速度Ｎとこの回転速度に応じて固定子２が変位させられたときの電機子巻線１２の鎖交磁束量φとの関係が図２（Ｂ）に示した関係と同様になるようにアクチュエータ及びばね５０の特性を設定すれば、電動機１の出力特性を図４に示したようにすることができる。

【００４９】上記の実施例では、電動機の回転速度の検出信号によって制御されるアクチュエータにより固定子を軸線方向に変位させるようにしたスラスト機構を用いたが、固定子２を手動操作により軸線方向に変位させるスラスト機構を採用することもできる。この場合には、電動機１の固定子２と手動操作部材とを連結手段により連結し、該手動操作部材を手動により操作することにより、固定子２を軸線方向に変位させて回転子磁極１６と固定子磁極１３との対向面積を変化させる。例えば、手動操作部材として車両のハンドルに設けられたグリップあるいはレバーに連結手段としてのワイヤーの一端を結合し、該ワイヤーの他端を固定子取付部材４６（図６参照）の他端５１に結合する。この場合には、電動機１の回転速度あるいは車両の車速に応じて手動によりグリップあるいはレバーを操作して固定子２を軸線方向に変位させることにより、電機子巻線１２の鎖交磁束量を調節して電動機１の出力特性を変えることができる。

【００５０】以上の各実施例では、直流電動機として、回転子が固定子の外側を回転するアウタロータ構造を有するものであったが、この電動機として、インナロータ構造を有するものを用いることもできる。この場合の電動機は、環状の継鉄部から３ｎ（ｎ：整数）個の突極部を径方向内側に向けて突出させた固定子鉄心の各突極部に電機子巻線を巻回してなる固定子と、該固定子の内側に配置されて外周に永久磁石からなる２ｎ極の回転子磁極を有する回転子とにより構成し、固定子鉄心の各突極部の先端部により形成される固定子磁極と回転子磁極とを径方向に対向させる構造とする。電機子巻線の鎖交磁束量を調節する磁束調節手段としてのスラスト機構は、前記第１実施例（図１参照）あるいは第２実施例（図６参照）の場合と同様に、固定子が取り付けられた回転軸を軸線方向に変位させる手段あるいは固定子を軸線方向に変位させる手段により回転子と固定子との間に軸線方向の相対的な変位を生じさせる機構を用いることができる。

【００５１】図７は本発明の第３実施例の構造を示したもので、この実施例では、直流電動機として、固定子磁極と回転子磁極とが軸線方向に対向する構造を有するも

のを用い、磁束調節手段は、電動機の回転子磁極と固定子磁極との間のギャップを変化させるように該電動機の回転子と固定子との間に軸線方向の相対的な変位を生じさせるスラスト機構により構成されている。図７において図１の各部と同等の相当部分には図１における符号と同じ符号が付してある。

【００５２】図７において、電動機１の固定子２は、環状円板形の継鉄５２の軸線方向の一方の面から、３ｎ（ｎ：整数）個の突極部５３を軸線方向に突出させた固定子鉄心５４と、該突極部５３に巻回された電機子巻線１２とからなっている。３ｎ個の突極部５３は周方向に等角度間隔で並ぶように設けられ、各突極部５３の先端部が固定子磁極１３となっている。この固定子２はカバー６の固定子取付部２１にねじ２２により取り付けられている。

【００５３】電動機１の回転子３は、中央部にボス１７を有する円板状の磁路構成部材５５と、該磁路構成部材５５の固定子鉄心の突極部と対向する側の面に固定された永久磁石５６とからなり、永久磁石５６は軸線方向に着磁されて周方向に交互に異極が並ぶ２ｎ極の回転子磁極１６を構成している。回転子磁極１６は固定子磁極１３と軸線方向にギャップ（キャップ長ｇ）を介して対向させられている。

【００５４】回転子３は、軸受８により回転及び軸線方向に摺動が可能に支承された回転軸７の一端側に取り付けられており、該回転軸７の他端側は車輪９との間に軸線方向への変位のみが許容される状態で車輪９に結合されている。電動機１の回転子３と固定子２との間に軸線方向の相対的な変位を生じさせるためのスラスト機構は、既述の第１実施例の場合と同様に、回転軸７を図示矢印方向に変位させるように駆動する遠心ガバナ機構１０からなり、車輪９の回転速度の上昇に伴って固定子磁極１３と回転子磁極１６との間の軸線方向のギャップ長ｇを増大させて電機子巻線１２の鎖交磁束量を減少させるように作動する。

【００５５】上記の実施例では、電動機の回転子３の回転軸７を軸線方向に変位可能に支持して、遠心ガバナ機構１０により回転軸７を軸線方向に変位させることにより固定子磁極１３と回転子磁極１６との間のギャップを変化させる磁束調節手段を用いているが、該磁束調節手段として、既述の第２実施例（図６）と同様に、電動機の固定子２を軸線方向に変位可能な状態で支持して、電動機の回転速度に応じて固定子２を軸線方向に変位させることにより、固定子磁極と回転子磁極との間のギャップを変化させるようにしたスラスト機構を用いることもできる。

【００５６】以上の各実施例では、電動機の回転子を一端側に取り付けた回転軸の他端側を直接車輪に結合したが、必要に応じて回転軸の他端側を減速歯車機構を介して車輪に結合するようにしてもよい。

【００５７】以上の各実施例では、直流電動機は２ｎ（ｎ：整数）極の回転子磁極と３ｎ極の固定子磁極とを有する３相構造のものであったが、回転子磁極及び固定子磁極が共に２ｎ極の単相構造である場合にも本発明を適用できる。この場合には、電動機の回転速度を制御するための制御系も単相制御方式とする。

【００５８】

【発明の効果】以上のように、本発明によれば、磁束調節手段により電動機の電機子巻線に鎖交する有効磁束量を調節できるようにしたので、電動機の回転速度に応じて電機子巻線の鎖交磁束量を調節することにより回転速度の広い範囲にわたって電動機の出力を大きな状態に維持することができる。従って、自動変速機構を用いたり電動機を大形化したりすることなく、低速域で大きな発生トルクが得られ、しかも高速回転が可能な電動車両用駆動装置を得ることができる利点がある。

【図面の簡単な説明】

【図１】本発明の第１実施例の構造を示す縦断面図である。

【図２】図１の実施例における回転速度と電機子鎖交磁束量との関係を説明するための線図である。

【図３】図１の実施例における電動機の制御系の構成例を示した回路図である。

【図４】図１の実施例における電動機で得られる出力特性を説明するための線図である。

【図５】図１の実施例を用いて得られる車両の走行特性を説明するための線図である。

【図６】本発明の第２実施例の構造を示す縦断面図である。

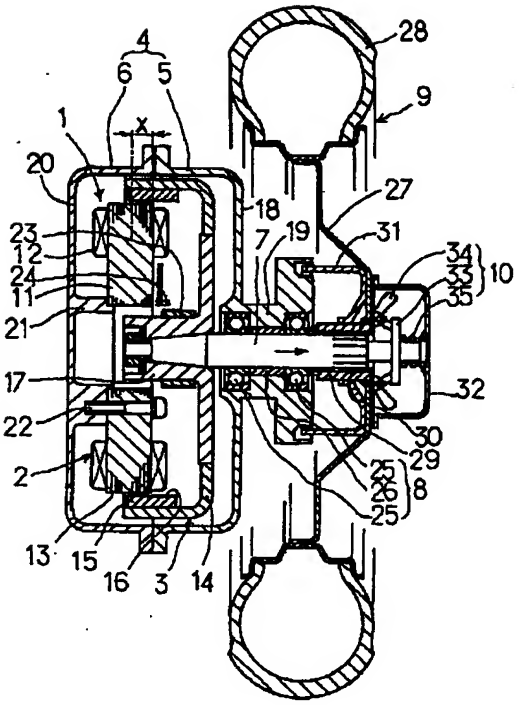
【図７】本発明の第３実施例の構造を示す縦断面図である。

【図８】電動機の電機子鎖交磁束量が異なるときの電動機出力の違いを比較して示した線図である。

【符号の説明】

１　直流電動機
２　固定子
３　回転子
７　回転軸
９　車輪
１０　遠心ガバナ機構
１１　固定子鉄心
１２　電機子巻線
１３　固定子磁極
１６　回転子磁極

【図１】


4
6
5
X
1
20
23
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21
17
22
2
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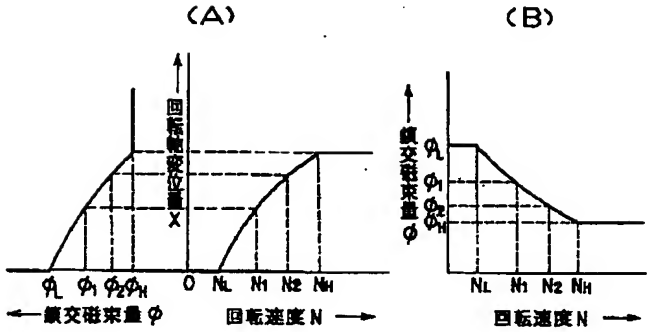
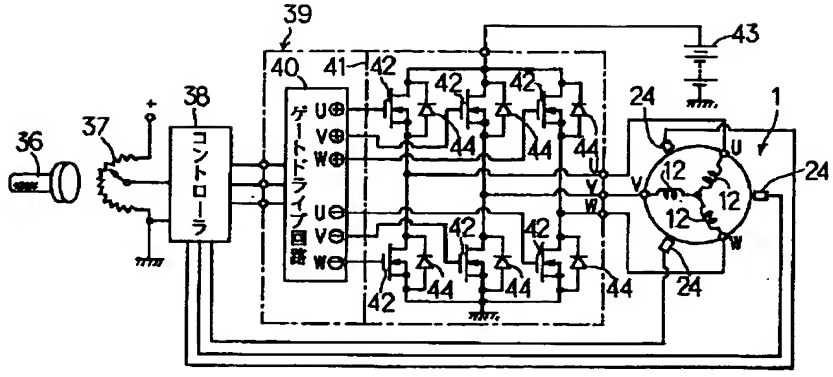
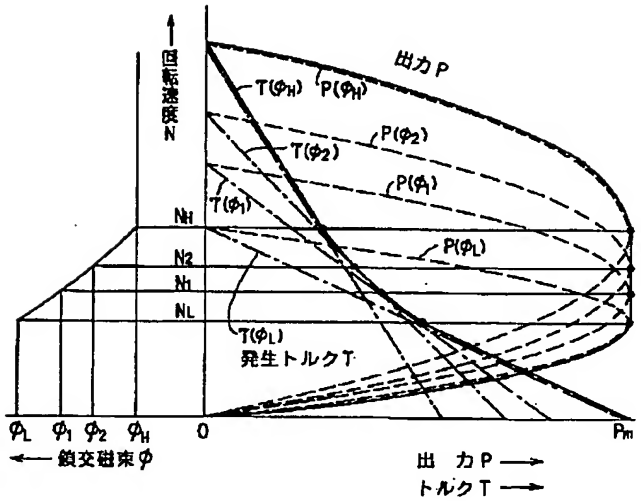
【図２】


(A)
回転制御位置 X
φL φ1 φ2 φH
0 NL N1 N2 NH
←鎖交磁束量 φ
回転速度 N →
(B)
鎖交磁束量 φ
φL
φ1
φ2
φH
NL N1 N2 NH
回転速度 N →

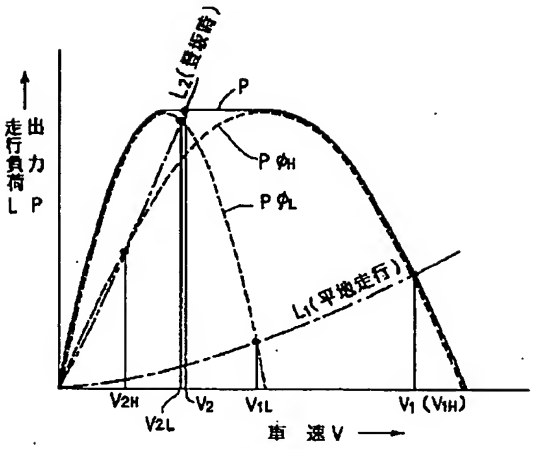
【図３】


39
40
41
42
43
38
コントローラ
ゲートドライブ回路
U⊕
V⊕
W⊕
U⊖
V⊖
W⊖
36
37
+
44
24
1
12
U
V
W

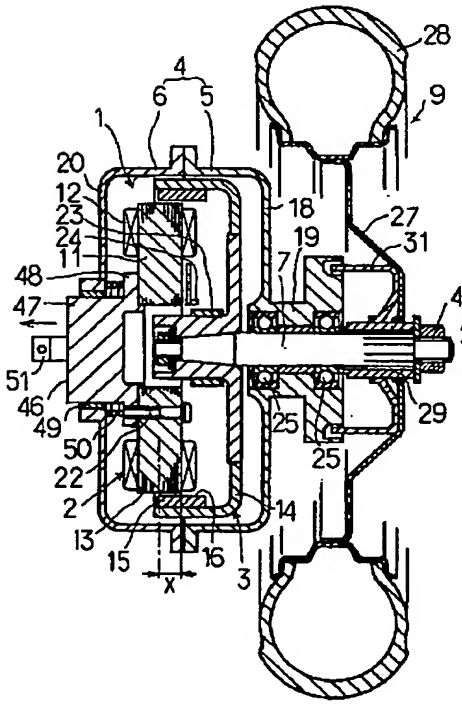
【図４】


回転速度 N
出力P
T(φH)
P(φH)
P(φ2)
T(φ2)
P(φ1)
T(φ1)
NH
N2
N1
NL
P(φL)
T(φL)
発生トルクT
φL φ1 φ2 φH 0 Pm
←鎖交磁束φ
出 力P →
トルクT →

【図５】


出力 走行負荷 L P
L2(登坂時)
P
P φH
P φL
L1(平地走行)
V2H
V2L
V2
V1L
V1 (V1H)
車 速 V →

【図６】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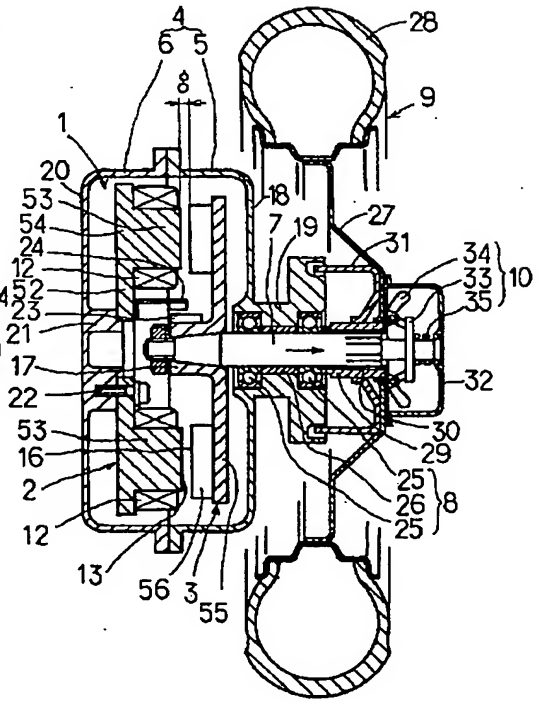
【図７】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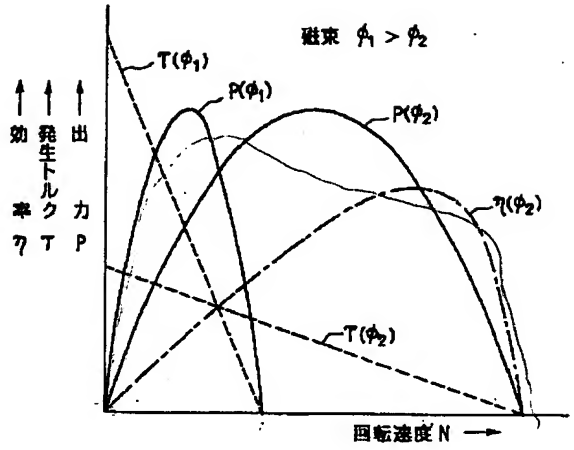
【図８】


磁束 $\phi_1 > \phi_2$
$T(\phi_1)$
$P(\phi_1)$
$P(\phi_2)$
$\eta(\phi_2)$
$T(\phi_2)$
効率 η
発生トルク T
出力 P
回転速度 N